REMARKS

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow.

Claims 8, 24, 25 and 28 are requested to be cancelled without prejudice or disclaimer. Claims 1, 10, 20, 27 and 29 are currently being amended. Support for the amendment to independent claim 1 can be found at least in original claims 12 and 16, and in the specification, for example, on page 14, lines 13-14. Support for the amendment to independent claim 27 can be found at least in original claims 12 and 16, and in the specification, for example, on page 14, lines 13-14, and in Table 5 of the specification and the description thereof. New claims 30-34 have been added. Support for the new claims can be found at least in FIG. 1 and the description thereof. No new matter is being added.

This amendment changes and deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

After amending the claims as set forth above, claims 1, 3, 10, 20, 27, 29 and 30-34 are now pending in this application.

Rejections Under 35 U.S.C. § 103

Claims 1, 3, 8, 10, 20, 24, 25 and 27-29 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,693,203 to Ohhashi et al. (hereafter "Ohhashi") in view of applicants' alleged admission in the Rule 132 declaration filed on April 12, 2004, or U.S. Patent No. 4,720,300 to Nishizawa et al. (hereafter " Nishizawa "), and further in view of alleged prior art admission on page 2, lines 1-28 of the instant specification. Applicants respectfully traverse this rejection for at least the following reasons.

In general, the high purity Nb sputtering target in claims 1 and 27 may be used for forming a Nb liner film of an A1 interconnection film having a resistivity of 4 $\mu\Omega$cm or less.

Claim 1

The high purity Nb sputtering target in claim 1 contains "Ta in a range of 550 to 3000 ppm" and "oxygen in a range of 10 to 200 ppm" as impurities. A dispersion of the Ta content in the Nb sputtering target of claim 1 is within 30%, and a dispersion of the oxygen content in the Nb sputtering target of claim 1 is within 80%.

The dispersion of the Ta content and the dispersion of the oxygen content are respectively defined by the following equation, for respective measured content values of 9 specimens sampled at respective predetermined positions in the target: dispersion (%) = {(maximum value - minimum value) / (maximum value + minimum value)} x 100.

Further, in the high purity Nb sputtering target in claim 1, an average grain diameter of Nb grains in the Nb sputtering target is 75 μm or less, each grain of the Nb grains has a grain diameter in a range of 0.1 to 10 times the average grain diameter, and a grain size ratio of adjacent grains in the Nb grains is in a range of 0.5 to 5.

In the high purity Nb sputtering target in claim 1, the Nb sputtering target is formed by melting due to multiple times EB melting so as to reduce the Ta content and the oxygen content and the dispersion in a Nb ingot, plastic working the Nb ingot at a working rate in a range of 50 to 98%, and heat-treating the plastic worked Nb ingot at a temperature in a range of 800 to 1300°C for one hour or more.

The structure, and in particular the (1) Ta and oxygen content, (2) the Ta and oxygen dispersion, and (3) the grain size parameters of the high purity Nb sputtering target in claim 1 is provided by methods recited for producing the target. By melting due to multiple times of EB melting, **(1) the Ta content and the oxygen content** in the Nb ingot **are reduced**, and Ta and oxygen are dispersed in the Nb ingot. Further, by plastic working the Nb ingot at the working rate in the range of 50 to 98%, an adequate amount of heat energy is given to the Nb ingot, and Ta and oxygen are further dispersed in the Nb ingot. Therefore, **(2) Ta and oxygen can be uniformly dispersed** in the Nb sputtering target. That is, the dispersion of

the Ta content in the Nb sputtering target can be made to be in a range of 30% or less, and the dispersion of the oxygen content in the Nb sputtering target can be made to be in a range of 80% or less.

Further, the energy given to the Nb ingot by plastic working destroys grains in the Nb ingot. By heat-treating the plastic worked Nb ingot, in other words, the Nb ingot with which the grains are destroyed, at a temperature in a range of 800 to 1300°C for one hour or more, the Nb grains in the Nb sputtering target can be controlled. Therefore, the Nb sputtering target in which the **(3) average grain diameter of the Nb grains is 75 μm or less, each grain diameter of the Nb grains are in the range of 0.1 to 10 times the average grain diameter, and the grain size ratio of the adjacent Nb grains is in the range of 0.5 to 5**, can be obtained.

Claim 27

The high purity Nb sputtering target in claim 27 consists essentially of Nb. The Nb sputtering target in claim 27 has a recrystallized structure formed by plastic working a high purity Nb ingot at a working rate of 55 to 95% to form a high purity Nb plate and by heat-treating the high purity Nb plate at a temperature of 800 to 1300°C for one hour or more. The structure, and in particular the grain size parameters of the high purity Nb sputtering target in claim 27 is provided by methods recited for producing the target.

The recrystallized structure of the Nb sputtering target in claim 27 includes the Nb grains which have the following conditions. An average grain diameter of the Nb grains is 75 μm or less. Each grain of the Nb grains has a grain diameter in a range of 0.1 to 10 times the average grain diameter. A grain size ratio of adjacent grains in the Nb grains is in a range of 0.5 to 5.

By plastic working the Nb ingot at the working rate in the range of 50 to 98%, an adequate amount of heat energy is given to the Nb ingot. The energy given to the Nb ingot by plastic working destroys grains in the Nb ingot. By heat-treating the plastic worked Nb ingot,

in other words, the Nb ingot with which the grains are destroyed, at a temperature in a range of 800 to 1300°C for one hour or more, the Nb crystalline structure becomes the recrystallized structure.

Thus, the Nb sputtering target having the recrystallized structure in claim 27 can be obtained based on the plastic working and the heat-treating. Further, the Nb grains in the Nb sputtering target of claim 27 are controlled based on the recrystallized structure. Therefore, the Nb sputtering target in which the **average grain diameter of the Nb grains is 75 μm or less, each grain diameter of the Nb grains are in the range of 0.1 to 10 times the average grain diameter, and the grain size ratio of the adjacent grains in the Nb grains is in the range of 0.5 to 5**, can be obtained.

Ohhashi and Nishizawa

Ohhashi discloses a sputtering target assembly composed of a three-layer structure of a sputtering target and a backing plate with one or more inserts interposed therebetween. The sputtering target of Ohhashi has a uniform microstructure having crystal grain sizes of no more than 350 μm. The sputtering target of Ohhashi is made of a material selected from the group consisting of a refractory metal of W, Mo, Ti, Ta, Zr and Nb. Further, Ohhashi discloses explosive bonding, hot rolling and grooved process, where the uniformity of recrystallized structure of the sputtering target would be destructured by the explosive bonding, hot rolling and grooved process.

Ohhashi does not disclose a sputtering target with a recrystallized structure. Rather, Ohhashi merely discloses that the sputtering target has a uniform microstructure, and not that the sputtering target has a recrystallized structure. Ohhashi, not disclosing a recrystallized structure, also does not disclose that each grain of the Nb grains has a grain diameter in a range of 0.1 to 10 times the average grain diameter, and a grain size ratio of adjacent grains in the Nb grains is in a range of 0.5 to 5, as in claims 1 and 27.

The Patent Office on page 3 states that the "sputtering target taught by Ohhashi is directed to uniform microstructure which requires uniform grain size." The uniform microstructure of Ohhashi, however, is not the same as uniform grain size. Therefore, the uniform microstructure described in Ohhashi does not demonstrate that each grain of the Nb grains in the sputtering target has a grain diameter in a range of 0.1 to 10 times the average grain diameter, and a grain size ratio of the adjacent Nb grains in the sputtering target is in a range of 0.5 to 5, as in claims 1 and 27. Ohhashi does not disclose or suggest the concrete recrystallized structure of its sputtering target, nor each grain diameter of the Nb grains and the grain size ratio of the adjacent Nb grains based on a recrystallized structure of the sputtering target.

Furthermore, Ohhashi does not disclose nor suggest a method for obtaining the recrystallized structure of the sputtering target. Ohhashi merely discloses that the coarsening of crystal grains is prevented when bonding the sputtering target and the backing plate. Thus, Ohhashi does not disclose a Nb sputtering target having a recrystallized structure, nor discloses a Nb sputtering target having the claimed grain diameters of the Nb grains and the claimed grain size ratio of the adjacent grains in the Nb grains, is obtained by plastic working the Nb ingot at the working rate in the range of 50 to 98% and by heat-treating the plastic worked Nb ingot.

Furthermore, with respect to claim 1, Ohhashi and Nishizawa do not disclose the claimed Ta and oxygen content. Specifically, Ohhashi does not disclose that the sputtering target contains "Ta in a range of 550 to 3000 ppm" and "oxygen in a range of 10 to 200 ppm" as impurities. With respect to Nishizawa, this reference merely discloses Nb metal containing Ta. Nishizawa merely discloses a process for producing Nb metal of ultra-high purity, and does not disclose a sputtering target made of the Nb metal of ultra-high purity.

In the Nb sputtering target in claim 1, not only is the Ta content and the oxygen content in the Nb sputtering target reduced, but Ta and oxygen are uniformly dispersed in the Nb sputtering target which contains "Ta in a range of 550 to 3000 ppm" and "oxygen in a range of 10 to 200 ppm" as impurities. Nishizawa does not disclose that Ta and oxygen are

uniformly dispersed in the Nb metal, nor discloses a dispersion of Ta content in the Nb metal and a dispersion of oxygen content in the Nb metal as the dispersion is recited in claim 1.

The Patent Office on page 3 of the Office Action states that the "Nb sputtering target of Ohhashi would inherently possess Ta and O as inevitable impurities. Since Ta and O are inevitable impurities, their dispersion would be uniform in Nb sputtering target."

The fact that the Nb sputtering target of Ohhashi may contain Ta and oxygen as inevitable impurities, however, does not suggest that Ta and oxygen are uniformly dispersed in the Nb sputtering target, because the dispersion will still depend on the manufacturing method. Ta and oxygen as inevitable impurities have a possibility of being segregated in the Nb sputtering target. In particular, it is easy to segregate "Ta in a range of 550 to 3000 ppm" and "oxygen in a range of 10 to 200 ppm" in the Nb sputtering target. As shown in Tables 1 and 3 in the present specification, depending on the manufacturing method of the Nb sputtering target, Ta and oxygen may not be uniformly dispersed in the Nb sputtering target, but may instead be segregated in the Nb sputtering target. In the Nb sputtering target in claim 1, in order to disperse uniformly "Ta in a range of 550 to 3000 ppm" and "oxygen in a range of 10 to 200 ppm" in the Nb spattering target, the Nb sputtering target is formed by melting due to multiple times of EB melting, plastic working the Nb ingot at a working rate in a range of 50 to 98%, and heat-treating the plastic worked Nb ingot at a temperature in a range of 800 to 1300°C for one hour or more.

Ohhashi and Nishizawa do not disclose the Nb sputtering target in which Ta and oxygen are uniformly dispersed, nor any method for dispersing uniformly Ta and oxygen in the Nb sputtering target for the Ta and oxygen content levels recited in claim 1. Nishizawa discloses a process for producing Nb metal of "ultra-high purity." Therefore, Nishizawa does not disclose that when the Nb metal contains "Ta in a range of 550 to 3000 ppm" and "oxygen in a range of 10 to 200 ppm," Ta and oxygen is uniformly dispersed in the Nb metal.

Thus, Ohhashi and Nishizawa do not disclose nor suggest a Nb sputtering target in which a dispersion of the Ta content is within 30% and a dispersion of the oxygen content is within 80%. Further, Ohhashi and Nishizawa do not disclose nor suggest that such a Nb

sputtering target is obtained by melting due to multiple times of EB melting, plastic working the Nb ingot at a working rate in a range of 50 to 98%, and heat-treating the plastic worked Nb ingot at a temperature in a range of 800 to 1300°C for one hour or more.

The claims are patentable for at least the same reasons as their respective independent claims, as well as for further patentable features recited therein.

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by the credit card payment instructions in EFS-Web being incorrect or absent, resulting in a rejected or incorrect credit card transaction, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicants hereby petition for such extension under 37 C.F.R. §1.136 and authorize payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

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